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What's Happening in the . . .

UTILIZATION

SECTION AT RESEARCH DIVISION

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ABSTRACT

An overview is given of the major activities of the Utilization Section.

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TO: Dr. D. Mills
Director of Research

We strive for excellence in service to our customers through... the use of modern technology and practices.

-from 'The Corporate Direction'

UTILIZATION RESEARCH

Our goal is to provide technological innovation and support to improve customer benefits and power system utilization through developments in end-use technology.

Sometimes this requires DEVELOPING NEW APPLICATIONS of electricity such as microwave processing of ceramics.

Other times it requires IMPROVING THE EFFICIENCY AND EFFECTIVENESS of existing equipment such as optimizing the performance of heat pumps for space heating in northern climates.

Finally, it may require DETERMINING THE PERFORMANCE CHARACTERISTICS of new products by laboratory and field testing, such as heat recovery systems for restaurant kitchens.

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COMMERCIAL

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TECHNOLOGY TRANSFER

"Ontario Hydro has a history of transferring technology to the industries of Ontario. We hope our current efforts will help to improve the competitiveness of our manufacturers."

- L.G. McConnell, Vice-President,

Hydro's industrial customers, large and small, frequently experience difficulty in identifying and evaluating the most appropriate electrotechnologies for their process despite the enhanced productivity and profits these technologies can bring. The difficulties may occur because the customer has a limited knowledge of what is available, lack of reliable performance data for the particular product type, or the reluctance of an equipment supplier to demonstrate the 'hands-on' applicability because of the expense involved. The technology-transfer program attempts to overcome these difficulties by applying Research Division resources to our customers' needs.

Goal

- To support the efficient use of electricity by Ontario industry in order to raise efficiency, productivity, profits, and employment.

Work Program

- Provide technical consultation to Ontario manufacturers on methods of improving specific processes using electrotechnologies. This will involve laboratory and/or field demonstrations of new applications of existing electrotechnologies, including: microwaves, infrared, dehumidification, radio-frequency, resistance, induction, and ultraviolet.

- Funded by Marketing Operations Division

Deliverables

- Determination of the most appropriate electrotechnology for specific customer applications.

- Information on the performance and economic impact of electrotechnologies in specific customer applications.

- Technical literature reviews, technology information summaries, and presentations at customer seminars.

Future Impacts

The trend to marketing products on a world-wide basis will continue in the future. In order to survive, Ontario manufacturers will have to compete in the global marketplace. Our recent work with industry has demonstrated that the rational use of electricity can provide major benefits to manufacturers by increasing productivity and product quality, leading to lower costs. Since the future health of the Provincial economy is tied to the health of our manufacturing sector, the application of electrotechnologies will take on increased importance.

Ontario Industry Responds

From a Cutting Chain Manufacturer: (Photo) *"I was very impressed with the speed at which your staff reacted to my limited timetable. ...within five to ten minutes of arrival we were 'hands-on' at work. ...lab testing was brought on stream to establish consistency and quality. All this ... would have been totally out of the question had I been trying to prove these methods on my own."*

From an Automotive Parts Manufacturer: *"The few experiments we did proved to me that our goals can be achieved, and inexpensively, with the short-wave IR method... Again, thank you for your help - I learned another side of Ontario Hydro!"*

From a Food Processor: *"The [microwave and radio-frequency] units were fully equipped to answer the essential questions of power requirement, reflective power and residence time. ...the information gathered allowed us to provide microwave suppliers with our process requirements so that they could arrive at a reasonable design and cost estimate."*

From an Automotive Parts Manufacturer: *"Our company is now designing a new production facility.... It was important to our plans to explore the advantages, disadvantages and design parameters of [using infrared] IR. An investigation of this sort would have been difficult in our limited engineering section ...."*

From a Process Equipment Manufacturer: *"We are encouraged by Hydro's interest in industry's problems. The Industry-Hydro program proved to be a very successful way for us to test our electrical equipment and to pass one of the hurdles in our development program."*

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DRYING PROCESSES

"Electricity offers a very wide range of drying techniques... [which] can save money by lowering energy costs, shortening drying times, providing more consistent quality, saving production space and in some cases lowering capital costs."

- P.J. Hulls, drying and dielectric specialist,
Electricity Council, 1985

Drying processes account for ~25% of the total energy used in industrial processes. Electrotechnologies can help to improve the efficiency of these energy-intensive processes and, thereby help Ontario industry to compete internationally. Dehumidification drying and the replacement of electric resistance with microwave kilns are two examples of current research activity that offer the potential for strategic conservation.

Goals

- To satisfy customer needs for faster, more controllable, and more efficient drying processes.
- To improve the efficiency of dehumidification drying systems to lower electricity demand and provide reduced operating cost to customers.
- To define design criteria for microwave applicators for new product drying applications not commonly available from equipment suppliers.
- To explore efficient electric drying techniques for high-moisture content, high-volume products requiring high temperature drying.

Work program

- Develop a new control for existing heat pump dehumidifier technology to reduce the energy consumption for softwood drying applications.

- Develop prototype microwave applicators for granular product drying and high temperature (ceramic) applications.

- Evaluate the feasibility of drying products with superheated steam and determine the possibility of heat recycling to improve drying efficiency.

- Assess the performance of innovative heat pump, microwave, and electric-hybrid drying systems through appropriate international contacts, literature reviews, and hardware assembly and evaluation studies conducted at OHRD facilities.

- Funded by Marketing Operations, Market Services and Development and Research Division and by Canadian Electrical Association.

Deliverables

- Continued technical support will be provided to Energy Management Segment & Technology Teams on dehumidification, microwave and radio-frequency processing.

- Design and performance information on advanced drying systems will be made available to other Hydro units and equipment manufacturers. This information will help planners, and designers assess the opportunities for new markets and improved efficiency in the electric drying area.

Future Impact

Many Ontario companies can benefit from adopting electric drying techniques which provide fast, efficient drying and often product quality improvements. Much of the current work is aimed at improving efficiency and performance which will produce additional customer benefits and provide capacity savings for Ontario Hydro.

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CONCENTRATING PROCESSES

Determining the appropriateness of an industrial process heat pump [or MVR] remains a highly site-specific exercise. The [Pinch] procedure assures proper thermodynamic placement and sizing of the heat pump, directs heat pump applications to operating regions where it is more cost-effective than heat exchange , assesses its true energy impact on overall process energy and heat exchanger area [& capital] requirements ...."

- A. Karp, Project Manager, EPRI, 1987

Reducing moisture content is an important process especially in the food and chemical industries. By demonstrating the benefits of the efficient use of electricity for industrial concentration processes, Ontario Hydro will help its industrial sector to improve productivity and become more competitive internationally. An added benefit to Hydro is the potential for strategic conservation through the replacement of electric resistance process heating with heat exchangers, MVR and membrane systems.

Goals

- To satisfy customer needs for a more efficient means of concentration compared to the methods they are presently using.
- To identify correct placement and sizing of heat pumps and MVR units in industrial processes for maximum heat recovery and maximum return on capital investment.
- To meet utility demands for concentrating processes which offer significant strategic-conservation potential.

Work Program

- Determine the present state-of-the-art of MVR.
- Investigate the feasibility and economic practicality of small MVR compressors less than 50 kW across small concentration processes.
- Develop a design specification for a steam compressor test facility.
- Purchase the necessary hardware and software to perform PINCH (process integration) studies of industrial processes to determine optimum heat pump and MVR placement and sizing.

- Provide MVR and PINCH technology support to the Food and Beverage and Chemical Segments. Prepare one or two generic case studies to demonstrate the effectiveness of PINCH as a siting tool.

- Participate in the repair Research's existing membrane unit. Conduct one or two generic case studies using the membrane unit.

- Funded by Marketing Operations, Market Services and Development and Research Division.

Deliverables

- A PINCH technology capability will be established at Ontario Hydro. This capability will be useful to planning and energy management groups wanting to assess the impact on overall plant energy consumption of heat pumps, MVRs, and other devices affecting plant heat flows (eg. motor replacement of steam turbines, cogeneration systems).

- Information on the application of MVR in the food & beverage and chemical segments will be developed through generic case studies of typical plants using PINCH techniques.

- Assistance will be provided to the Energy Management Segments' MVR programs.

- A state-of-the art report on MVR will be prepared. Potential applications and the feasibility of using small MVR across concentrating processes will be investigated and summarized.

- Feasibility and design study for a MVR test facility at Research will be prepared.

- Reliable performance information will be generated for one or two concentrating applications using membranes.

Future Impacts

The correct application of MVR and membrane devices can provide the industrial customer with economical concentrating processes and benefit the utility through lower energy demands. PINCH can be used to identify passive heat recovery potential and ensure the correct sizing and placement of MVRs and heat pumps in industrial processes. The resultant lower energy requirements reduce manufacturing costs while satisfying Ontario Hydro's desire for conservation of electricity.

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SURFACE TREATMENT PROCESSES

"In the last 15 years the conversion of electrical energy into infrared, ultraviolet and other forms of radiant energy has gained worldwide acceptance as an efficient method for modifying polymeric materials. The total impact of these (techniques), while significant, is still only a minor part of the total product manufacturing techniques currently in use today...the future use is expected to expand dramatically...with an overall annual growth rate projected to be between 10 to 20%"

- EPRI State-of-the-Art Assessment, 1986

Coating, curing, etching and other surface modifications are common to a wide range of manufacturing operations. Electrotechnologies based on infrared, ultraviolet and plasma offer major advantages over other methods: rapid cure, low processing temperatures, specialty products, high quality products, no pollution and substantial reduction in energy costs. The latter promises significant potential for strategic conservation.

Goals

- To satisfy customers needs for surface treatment processes with the advantages of electrically-based techniques.
- To provide a clean and safe environment both inside and outside of the work place.
- To meet utility demands for electrical techniques that offer significant strategic conservation potential.

Work Program

- Purchase new control and switching devices for existing infrared systems to offer increased versatility for both laboratory and in-plant demonstrations. Investigate the opportunities for improving the efficiency of electric infrared emitters.
- Commission new ultraviolet equipment and conduct tests on selected products to quantify the benefits of this electrotechnology and its potential for strategic conservation.

- Develop new apparatus for generating and applying microwave-induced plasma for selected surface treatment processes.

- Funded by Market Services and Development and Research Divisions.

Deliverables

- Continued technical support will be provided to Energy Management Segment Teams in infrared processing. This support will include demonstration and development of potential IR applications.

- Information on the feasibility of increasing the efficiency of electric infrared emitters and the opportunity of using ultraviolet processes as strategic conservation options.

- Technical information summaries will be prepared for ultraviolet and microwave plasma technologies to help energy management staff understand and exploit the benefits of these techniques.

Future Impacts

With an anticipated growth of up to 20% forecast for electric surface treatment methods, it will become increasingly important to ensure that Ontario Hydro is provided with sound technical advice to assess the potential not only for industrial applications but also for strategic conservation.

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MATERIALS AND AUTOMATION

"The field of materials science and engineering is in the midst of a widely acknowledged revolution, and one that is certain to be a key factor in shaping the global economy."

- Scientific American, October 1986

"It is anticipated by both CIM [Computer Integrated Manufacturing] system vendors and the managers of CIM installations that the effect of CIM on the [electrical] load factor ... is beneficial - almost unavoidably so. Certainly the experience to date of those interviewed for this study confirms this."

- EPRI Research Report 2613-7, June 1986

The creation of new materials and products is an important aspect of a diversified and growing economy. Electrotechnologies will find many new applications in these areas because they have the advantage of being easily incorporated into an automated environment. The automation of industrial processes provides considerable benefits to manufacturer, and also improves the load factor for Ontario Hydro.

Goals

- To explore efficiently using electricity to produce new materials.
- To demonstrate the automation potential of electrotechnologies.
- To investigate the strategic conservation potential of electrotechnologies in an automated work place.

Work Program

- Procure and evaluate the performance of high efficiency motors under various operating conditions.
- Conduct sintering (firing) tests of advanced ceramics (including high temperature superconductors) using electric techniques.
- Develop bonding techniques for zinc-oxide surge arrester elements aimed at producing devices to improve electric system reliability using advanced electrotechnologies.

- Demonstrate how an electrotechnology can be incorporated into a factory communication network, and investigate the resulting operational and control benefits.
- Outline the benefits and demonstrate the potential for applying radiant energy with robots.
- Demonstrate the potential for curing polymer composites with microwave energy for aerospace applications.
- Funded by Marketing Operations and Research Divisions.

Deliverables

- Information on the effects of voltage unbalance on energy efficient motor performance.
- Information on new techniques for processing advanced materials using electrotechnology.
- Case studies related to the integration of electrotechnologies into the automated work place. These will serve as application guides for both the manufacturers and users of electrotechnologies.

Future Impact

In many industries, the cost of energy is one of the smaller components of the total production cost, and consequently the energy efficiency of a new application may not play a significant role in the equipment selection. Since the impact of the energy consumption resulting from automation technologies and the processing of new materials will be felt most by Ontario Hydro, it is up to Ontario Hydro to provide guidance with regard to the energy effectiveness of these technologies.

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BURNER-ASSISTED HEAT PUMPS

"Bivalent heat pumps represent an improvement to the add-on heat pump concept. One such system, designed in Canada,... may make dual-fuel heating systems more competitive in the new-home market.

- EPRI Heat Pump Manual, 1985

Twenty-eight percent of all new homes in Ontario choose electric-resistance heating. This imposes an extra peak demand of 100 MW on Ontario Hydro every year. Such increases could easily be halved through the use of novel heating technologies such as a unique Canadian invention; the bivalent (burner-assisted) heat pump.

Goals

. To satisfy customer needs for efficient electric HVAC systems in cases where a full-sized electric service entrance would be prohibitively costly.

. To meet utility demands for heating systems that offer significant strategic-conservation potential.

Work Program

. Maintain detailed data monitoring of two advanced bivalent heat pump (Kool-Fire) systems at residential sites near Toronto.

. Guide the [Ontario] manufacturer in his production of a new, more-efficient model that will reduce auxiliary-fuel consumption to lower levels than ever.

. Conduct tests in the OHRD heat pump chamber to verify the above developments, and retrofit one or more of the field sites with the new model.

. Convert one or more of the closely-monitored field sites to a stored-fuel (propane) back-up system in order to demonstrate the viability of a single annual fill-up cycle.

. Add a domestic hot-water heating capability to the Kool-Fire heat pump in order to further enhance the efficiency and competitiveness of this electric-based energy system.

. Seek cooperation for a commercial-system monitoring project that will yield reliable cost-benefit information for the important roof-top market segment.

- Provide load-shape and performance information to regional and utility personnel through technical publications and presentations to key individuals and groups.

- Assist the Strategic Conservation Section in all aspects of any present and planned field demonstrations designed to gather marketing and load information from a large number of residential Kool-Fire installations in different parts of the Province.

- Prepare plans and seek cooperation for an area-based or utility-based field trial of several dozen units that can be monitored for their feeder-load characteristics and their strategic conservation potential.

- Funded by Market Services and Development and Research Divisions and by Canadian Electrical Association.

Deliverables

- New models of bivalent (burner-assisted) heat pump will be developed. They will go further than ever before in addressing utility concerns about lowering peak demands, reducing back-up fuel use, and including domestic hot-water production as an option.

- Reliable load-profile information will be generated to assist planners and analysts inside and outside Ontario Hydro in their assessment of the bivalent heat pump's strategic conservation potential, net revenue potential, and marketability.

- Assistance will be provided to other Hydro units in their efforts to exploit the benefits of this new technology.

Future Impacts

Over 300 MW of strategic conservation could be achieved if 50% of Ontario's existing electric furnace customers could be persuaded to install a Kool-Fire based system. In addition to heating, such systems would also provide cooling comfort (and revenue) in the summertime. Ontario Hydro could follow the lead of certain west-coast utilities in the marketing and distribution of both bivalent heat pumps and the propane needed to run them.

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ADVANCED COLD-CLIMATE HEAT PUMPS

"The [Ontario Hydro] heat pump is one of the most efficient heat pumps to be built for this climate and is capable of running at temperatures down to -26 C with a COP in excess of 1.5."

- KeepRite Inc., final report to CEA, 1987

In Sweden, a country whose climate, population, and power system are all about the same as the Province of Ontario's, over 7,000,000 MWh is saved annually through the use of appropriate heat pump technologies. This achievement, which has eliminated the need for more than one whole nuclear unit, has cost Sweden only $100 million.

Goals

- To satisfy customer needs for efficient electric air-source heat pumps under our climatic conditions (which present the most severe operating chailenge in the world).
- To meet utility demands for heating systems that offer significant strategic-conservation potential.
- To advise Ontario manufacturers on the design of top-quality heat pumps that meet the above two goals.

Work Program

- Maintain detailed data monitoring of two advanced prototype systems at residential sites in Central and Georgian-Bay Regions.
- Develop new defrost and refrigerant-control electronics using the OHRD prototype heat pump, and the assistance of the OHRD Electronics Design Section. Retrofit the field sites with the new microprocessor package.
- Examine the performance of commercially-available advanced defrost controls and conduct a retrofit trial on six heat pumps in the Toronto area to gauge the success of these new products.
- Provide load-shape and performance information to utility planning personnel through technical publications and presentations.

- Assess the performance of other advanced air-source heat pump systems through appropriate international contacts, literature reviews, and hardware evaluation in the OHRD facilities.

- Prepare plans and seek cooperation for an area-based or utility-based field trial of several dozen advanced cold-climate heat pumps that can be monitored for their feeder-load characteristics and their strategic conservation potential.

- Funded by Canadian Electrical Association and Research Division.

Deliverables

- New models of cold-climate heat pump will be developed. Their cold-weather performance and versatility will be unsurpassed in the marketplace, and their production will be kept within the reach of Ontario-based manufacturing operations.

- Reliable load-profile information will be generated to assist planners and analysts inside and outside Ontario Hydro in their assessment of the cold-climate heat pump's strategic conservation potential, net revenue potential, and marketability.

- Assistance will be provided to Ontario industry in their efforts to bring advanced heat pump technology with beneficial load characteristics to the marketplace.

Future Impacts

Although present-day air-source heat pumps cannot save anything in demand at the time of the system's peak, advanced cold-climate heat pumps have been demonstrated that can save over 2kW for every customer equipped with electric resistance heating. In future Provincial energy scenarios based on an electric economy, this saving could represent vast capacity savings for Ontario Hydro. In addition, such systems would also provide cooling comfort (and revenue) in the summertime.

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GROUND-SOURCE HEAT PUMPS

"The most advanced heating and air conditioning system available today."

- EnerMark Facts For Builders Sheet, 1987

From less than 500 three years ago, the ground-source heat pump (GSHP) has grown to over 5000 installations in Ontario today. Most of these units are installed residentially, where they can cut energy and demand requirements by up to 65%. This achievement represents a benefit to the supply utility, but is costly to the homeowner. However, the commercial and institutional market is poised for a sales explosion because first costs of GSHP systems are often actually lower than for a gas-heat/electric-cool installation.

Goals

- To evaluate the technical and economic performance of this major new class of electric-based renewable-energy heating, cooling, and hot water system.
- To explore ways to reduce the installed cost of a heating system that offers significant strategic-conservation potential.

Work Program

- Plan and execute a detailed field monitoring project involving 10 residential GSHP sites in Bayview Hill, near Toronto, and 23 additional sites in all other areas of the Province.
- Conduct tests of specific GSHP equipment in the OHRD heat pump test facility, in support of the field data-gathering project above.
- Assist the Strategic Conservation Section in all aspects of their GSHP field demonstrations including the analysis and interpretation of load information, and the investigation and documentation of any field problems.
- Participate in an international field trial and demonstration of a new type of "direct-expansion" GSHP system. Ontario Hydro and the Swedish State Power Board will install and monitor systems in their own countries, and will produce a joint detailed project report on the outcomes. Key assessments will include the potential of this type of system for reducing the installed cost of GSHP systems in urban areas.
- Provide load-shape and performance information to regional and utility personnel through technical publications and presentations to key individuals and groups.
- Monitor the performance a commercial installation of a GSHP heating/cooling system in the Janet Lee Public School in Stoney Creek.
- Monitor the performance of a GSHP heating/cooling system installed at the TI Automotive Plant in Strathroy.
- Funded by Marketing Operations, Market Services and Development and Research Divisions and by Canadian Electrical Association.

Deliverables

- Performance and costing data on a new kind of ground-source heat pump - the direct-expansion heat pump - will be obtained in Canada's first monitored field trial of this residential system.
- Reliable load-profile information will be generated to assist planners and analysts in their assessment of the ground-source heat pump's strategic conservation potential, net revenue potential, and marketability.
- Assistance will be provided to other Hydro units in their efforts to exploit the benefits of this new technology.

Future Impacts

Over 200 MW of strategic conservation could be achieved by the year 2000 if just 1/4 of the new houses that would have gone all-electric were persuaded to install a ground-source heat pump instead of electric resistance heating. A plastic-pipe ground coil can be expected to last over 30 years and can produce 5kW of heating for the customer at the time of our system's peak. To provide the same capacity in electric generation could cost Ontario Hydro over twice the price of installing a 'free' buried coil for every home that was willing to install a GSHP.

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Installation of a copper, direct-expansion loop for a ground source heat pump test home in Etobicoke.

DEMAND SOLUTIONS
FOR ELECTRIC HEATING CUSTOMERS

"[Ontario] Hydro will probably be able to handle Ontario's demand for electricity until about the year 1996."

- Electricity and Our Energy Future,
O.H. System Planning Brochure, 1987

There are 370,000 electrically-heated houses in Ontario, representing a winter peak demand of almost 4,000 MW. Many of these houses are in the north, and many utilize baseboard-heating systems that are difficult and costly to retrofit. For this class of customer, attractive new technologies from other parts of the world may be adaptable to Ontario conditions for reducing or eliminating the winter peaks of these users. Foremost among these are distributed (ductless) heat pump systems and outdoor-mounted instant hydronic heating systems, both from Japan.

Goals

- To satisfy customer needs for modernized dual-fuel systems that feature new-fuel-hardware and low-cost modular installation.
- To meet utility demands for off-peak heating systems that can be controlled to deliver significant strategic-conservation potential.
- To offer hydronic- or baseboard-heated customers an economical, alternative, high-efficiency heating system that also provides a summer-cooling option.

Work Program

- Maintain awareness of alternative heating systems used in other countries where the use of such systems has the potential of being adapted to solve the problem of winter peak demand in Ontario.
- Procure and evaluate the Naritsu instant, hydronic, fuel-fired boiler system with a view toward applying it at peak-demand times in houses with central electric furnaces, under-sized heat pumps, or electric distributed systems.
- Procure and evaluate a Japanese distributed (ductless) heat pump system with a view toward applying it as an energy-efficient heating/cooling retrofit system in houses with baseboard or radiator heating systems.

- Evaluate the opportunities and barriers involved in combining certain attributes of both Japanese and North American heating systems to produce a final product uniquely targeted to the needs of Ontario customers and Ontario utilities over the next two decades.

- Project the performance and impact of various new-technology scenarios in order to assist the Strategic Conservation Section and other planning units, in their evaluation of future strategic conservation potentials.

- Funded by Market Services and Development and Research Divisions.

Deliverables

- The Naritsu wall-mounted instantaneous-hydronic boiler system will be demonstrated in operation under laboratory conditions using both natural gas and bottled propane as a fuel source.

- A practical multi-split (ductless) heat pump system will be obtained and operated under laboratory conditions. Its suitability under North American weather conditions will be assessed. Load-profile projections will be generated to assist planners and analysts in their assessment of the unit's strategic conservation potential, net revenue potential, and marketability.

- Assistance will be provided to other Hydro units in their efforts to exploit the benefits of these new technologies.

Future Impacts

The re-vitalization of dual-fuel heating programs using new-technology equipment on the fuel side could play a significant role in winter-peaking utility energy-supply schemes well into the 21st century and the ultimate "hydrogen economy" to follow. Ontario's current 4,000 MW potential in the residential sector alone will grow significantly over the next 20 years. Even a modest penetration of such systems into the existing market could represent more strategic conservation than any other single option.

Ontario Hydro could follow the lead of certain mid-west electric cooperatives in the marketing and distribution of instantaneous-hydronic peak-heating packages and the propane needed to run them.

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APPLIANCE AND HEAT PUMP STANDARDS

"The [Energy Efficiency] Act will allow the government to introduce, as necessary, minimum energy efficiency standards for defined products, such as refrigerators, freezers, clothes dryers and home heating equipment."

- Government House Leader on behalf of
R.C. Wong, Ontario Minister of Energy, 1987.

Certain appliances contribute significantly to the loads that Ontario Hydro must anticipate serving. These appliances also contribute significantly to the customer's energy bill. Unfortunately, many customers in the residential sector do not have the buying opportunity or power to choose the product or design that would serve them best in these areas. Space heating, water heating, and refrigeration are, in descending order, the greatest energy-consumers in a house today. Even the smallest of these, refrigeration, accounts for about 1,000 MW of Ontario load, every hour of the day, every day of the year. It is estimated that better refrigerators could cut this number in half!

The purpose of the Energy Efficiency Act, introduced in the Ontario Legislature on December 16, 1987, is "to encourage energy efficiency by setting energy efficiency standards for appliances and products sold in Ontario." The testing of such products to "acceptable and recognized procedures" inevitably involves the use of CSA Performance Standards. Ontario Hydro Research Division is often represented on these technical committees and sub-committees, and our facilities and expertise often provide the only non-manufacturer technical input that can be used to prove the case for higher efficiency on the consumer's behalf.

Goals

- To satisfy customer needs for efficiency information that will assist in the selection of high-performance electric systems to supply space heating, water heating, refrigeration, and cooling.

- To represent Energy Management Branch, utility, and customer needs on CSA technical performance committees and sub-committees in the area of electrical product efficiency.

Work Program

- Maintain and develop Ontario Hydro's sophisticated product-testing laboratory facilities and test chambers in good working order to anticipate present and future needs in the area of efficiency testing.

- Represent Ontario Hydro on the CSA Technical Committees on Air-source Heat Pumps, Ground-Source Heat Pumps, Air-Conditioners, Electric Water Heaters, etc.
- Conduct limited tests in the OHRD heat pump chamber and energy management laboratory in support of the above activities.
- Lay the basis for related performance tests of electrical products where such performance might be a critical factor in the consumer acceptance of high-efficiency electrical options. For example, the noise and reliability testing of residential heat pumps are product-performance-related areas that could be included in the CSA Standard.
- Assist the Product Development Department in all aspects of any present and planned standards activities, including revision of "Energuide" appliance testing standards.
- Funded by Market Services and Development and Research Divisions.

Deliverables

- New product test standards
- Reliable product-performance information.
- Advice to other Hydro units in their efforts to improve the performance of electrical products.

Future Impacts

Through efficient appliance development, demonstration, and promotion, Ontario Hydro will create significant energy-consumption choices for Ontario's appliance buyers. This change will benefit the electrical system by reducing Ontario's electrical demand by hundreds of megawatts.

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WATER HEATING

"Because water heaters' peak demand seldom coincides with Hydro's system peak, they can be served very efficiently and profitably."

- Residential Marketing, 1985.

Electric water heating uses 8% of Ontario Hydro's annual production. Its steady demand profile makes it a superior load for the electrical system. For our customers, it constitutes a basic energy service performed cleanly, economically, controllably and reliably by electricity. Improved technologies will help Hydro to retain and expand its market share.

Goals

- Develop new water heating technologies & applications.
- Increase utilization efficiency of water heating systems.
- Understand existing & future water heating loads, including their load management potential and possible linkages with other loads.

Work Program

- Develop more efficient (advanced insulation systems, increased storage capacity), safer (minimize bacterial contamination), load-controllable water heaters.
- Measure load profiles of actual usage in a residential and commercial establishments.
- Investigate criteria for proper system design & sizing, including distribution effects.
- Study the integration of water heating with other house mechanical systems.
- Funded by Marketing Operations, Market Services and Development, and Research Divisions and by the Canadian Electrical Association.

Deliverables

- Development program for advanced water heating systems, energy conserving devices & technologies, consisting of the following phases: concept identification, design, feasibility study, prototype creation, lab testing & support for commercialization.
- CEA electric water heating manual, ASHRAE handbook input, magazine articles, etc.
- Confirmation of performance, via lab test & field trial, of innovative appliances combining water heating.

Future Impacts

Incorporation of better water heating technologies into future Energy Management programs will help reverse the erosion of this high load-factor, bread-and-butter electrical load by providing a superior service to customers. The general distribution of water heaters with larger storage capacity in rental programs, etc, will also provide hundreds of megawatts of load management capability for the bulk electrical system.

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HEAT RECOVERY & THERMAL STORAGE

"Today, customer satisfaction depends upon our ability to provide an electrical energy service that not only improves working and living conditions, but also reduces electricity bills and energy consumption."

- Ontario Hydro 1986 Annual Report

Using waste heat from one process as input to another is an efficient & cost-effective use of resources. Heat pump technology is often utilized to perform this heat recovery from air or water flows. If the source & sink are mismatched in time, then thermal storage may also be required. Storage can also be used to shift heating loads off-peak. Heat recovery should only be utilized after individual appliance efficiencies have been improved as much as practicable.

Goals

- Characterize & promote heat recovery opportunities in commercial sectors.
- Verify the operating characteristics of innovative, integrated residential mechanical appliances.
- Characterize innovative load management equipment in a systems context.
- Support energy efficiency standards and other initiatives.

Work Program

- Investigate the potential for heat recovery in laundries & similar businesses.
- Check the specifications & operation of novel residential heat recovery equipment/combination appliances, in lab & field.
- Support heat recovery initiatives in the hospitality, laundering & food service industry.
- Testing specifications & reliability of new residential thermal storage devices.
- Participate in the development of further appliance efficiency initiatives.
- Funded by Marketing Operations, Market Services and Development and Research Divisions.

Deliverables

- Demonstration project in a laundry.
- Mature heat recovery program in the restaurant sector.
- Confirmation of operation of residential heat recovery equipment, ready for demonstration projects & full use by energy management.

- Confirmation of performance of improved off-peak storage furnaces.
- Improved appliances available to informed customers.

Future Impacts

General implementation of heat recovery, appliance efficiency and peak shifting opportunities throughout the residential and commercial sectors will increase the cost-effectiveness of the energy services provided to Hydro's customers, saving homeowners hundreds of dollars per year. The impact on the electrical system will be lessened by thousands of megawatts.

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Field installation of a heat pump water heater in a restaurant kitchen.

BUILDING SCIENCE

"The challenge facing people living in cold climates is to maintain and even increase ... building energy savings while minimizing indoor air pollutant concentrations so that they can live in healthful and comfortable, yet economical, indoor environments."

- Health & Welfare Canada, 1985.

Incentive programs to decrease building energy demand on the electrical system need to take account of real-life technical effects of thermal envelope upgradings and the potential for indirect consequences, while maintaining or improving the service that electricity affords (comfort, etc). Any building operates as a system, so that changes can result in "unforeseen" impacts.

Goals

- Understand the requirements for ventilation, air cleaning, etc to ensure adequate indoor air quality in occupied buildings, and the ramifications for the electrical system.
- Understand the potential and risks from significant upgrading of the thermal envelopes of existing houses.
- Define the optimum new house envelope/equipment to give maximum amenity at minimum energy cost.
- Explore opportunities for utilizing advanced fenestration systems in residential & commercial operations, & the resulting improvements in amenity & energy usage.

Work Program

- Contribute to the development of strategic conservation programs in thermal envelope retrofits.
- Contribute to the process of introducing mechanical ventilation into the general housing stock & characterizing the effect on customers, allies, the electrical system, etc.

- Maintain technical currency in the area of advanced window systems, study appropriate applications of these new technologies & test such applications as required.
- Keep abreast of developments in the characterization of & requirements for adequate indoor air quality.
- Contribute to demonstrations of advanced houses.
- Funded by Marketing Operations, Market Services and Development and Research Divisions.

Deliverables

- Mature programs yielding significant demand reductions in new & existing housing without major liabilities.
- General acceptance of the need for mechanical ventilation in housing, & characterization of the new electrical demand thereby imposed on our system.
- Indication of the potential for utilizing new window technologies.

Future Impacts

Programs to save thousands of megawatts can be based in part on a technical understanding of building science. This understanding will also minimize the potential for substantial liabilities arising from unwanted side effects. The ultimate result will be a stock of buildings with improved thermal characteristics and providing a better indoor environment, which will increase the health, wealth and productivity of Hydro's customers as well as control the demands on the bulk electricity system.

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